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(54) APPARATUS FOR DISPENSING MATERIALS TO CONTAINERS

(71) We, B.D.H. CHEMICALS LIMITED, a British Company, of Clarges House, 6/12 Clarges Street, London, W1Y 8DH, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to apparatus for dispensing materials to containers.

An object of the invention is to provide such an apparatus which permits a container to be dispensed, with a predetermined quantity of a substance, which may be a liquid or a flowable solid substance, regardless of the weight, size or shape of the container.

According to the present invention, there is provided a dispensing apparatus comprising a weighing unit having a platform adapted to receive a container to be charged with substance and a load-cell connected to the platform arranged to produce signals dependent on the weight on the platform; an electronic control unit arranged to receive the signals produced by the load-cell and operable in response to such signals first to sense the tare weight of a container on the platform and then, subsequently, to measure the weight of the charge supplied to the container; and a dispensing unit automatically operable in response to command signals provided by the electronic control unit to open when the tare weight of the container has been zeroed, and then to close when a predetermined weight of substance has been dispensed into the container.

The zeroing interval can be very short, preferably only a fraction of a second. The device is accurate to better than $\pm 0.5\%$ of the programmed charge, $\pm 0.2\%$ being normally obtained.

The dispensing unit can be arranged so that all or part of it can be quickly replaced when it is desired to change the material being dispensed by the apparatus. This avoids the need for the time-consuming cleaning operations which are sometimes required with known dispensing apparatus, such cleaning operations sometimes taking at least 1½ hours.

In the accompanying drawings:

Figure 1 is a perspective view of a filling apparatus constructed according to the invention,

Figure 2 is a sectional view of a valve forming part of the apparatus,

Figure 3 is a sectional view of a weighing, head forming part of the apparatus,

Figure 4 is a schematic block diagram illustrating various components of the apparatus, and

Figures 5a, 5b and 5c are electronic circuit diagrams.

In the illustrated embodiment of the invention, an apparatus for dispensing liquids to containers C comprises a dispensing head 1 which is connected by pipework 2 to a reservoir (not shown) for the liquid and includes a valve unit 3 which can be opened to permit liquid to flow out of the head into a container beneath it and closed when it is desired to terminate the flow on completion of a dispensing operation. In the illustrated embodiment the valve is operated pneumatically as hereinafter described but it can be operated electrically, as by a solenoid, or in other suitable ways. In all cases, the valve operates in response to command signals from an electronic control unit 4. The valve control mechanism (to be described hereinafter) is arranged so that towards termination of the charging operation the liquid will reduce its flow rate into the container before the valves final closure signal. This leads to an accurate dispensing.

In an alternative arrangement intended for the dispensing of powders, the valve as an example can be replaced by a rotatable screw conveyor, rotation of which is controlled by commands from the electronic control unit 4.

A weighing unit (illustrated in Figure 3) is located beneath the dispensing head 1 and

includes a weighing platform 5 on which containers C to be charged can be placed as shown in Figure 1. The containers C can be placed on the platform 5 manually or they can be supplied to the platform by a suitable conveyor mechanism. The weighing unit also includes a load cell 6 which is mechanically connected by a platform support 7 with the platform 5 so as to be responsive to changes in the mass weight. This load cell 6 is connected to the control unit 4 through an amplifier circuit 8 so as to supply that unit 4 with signals dependent on the weight of the load on the platform 5.

The electronic control unit 4 includes a digital voltmeter 9 (which is arranged to display a digital reading of weight and is hereinafter called a display with a visual display on a display panel 10. The reading displayed corresponds to the signals from the amplifier 8. When an empty container C is placed on the platform 5, a signal corresponding to the presence of a container C will be transmitted from the amplifier 8 to the digital display 9 of the control unit. This reading or signal will be held until a machine operator has pressed a manually operated "start" button 11 to provide a start signal, when the reading on the digital display 9 returns to zero automatically, and when at zero automatically commences the filling sequence by causing a first command signal to be transmitted from the control unit 4 to a pneumatic control unit 12 controlling the dispensing head 1 thereby to open the dispensing valve 3 so that substance can commence to flow into the container C. The digital display 9 is so calibrated that it will display a reading indicative of the weight dispensed into the container. When a desired weight charged into the container C has been monitored by the digital display 9 a second command signal will be sent to the valve 3 to part close the valve and so reduce the flow of substance, followed by a command to close the valve 3. The apparatus is adjustable to enable the weight at which this command signal is sent to be varied or preset.

It will be appreciated that if there is no vessel to tare weight on the platform 5, the command signals required to initiate a dispensing operation are so safeguarded that a filling command signal cannot be sent.

Should the "start" button 11 be pressed a second time, for example by someone attempting to put two charges into one vessel, the combined weight of the tare and first charge would exceed the maximum permissible tare and prevent the dispensing valve from being operated a second time. The electronic control unit 4 is arranged so that it has to be re-set for each change in container range of full weight i.e. 500 grams. 1 kg 5 kg. 10 kg. etc.

The electronic control unit 4 is illustrated in detail in Figures 4 and 5 and comprises circuits, namely a zeroing and weight level identification circuit and a sequence control circuit including relays which operate to control an automatic dispensing or filling cycle, the circuit being connected to a pneumatic control unit 12 controlling the filling valve 3.

The sequence control circuit operates from a suitable electric supply through a power unit 13 which supplies power, conveniently of 24 volts, and can be switched on or off manually by a master key switch 14a. The circuit also includes an emergency stop switch 14b which, once pressed, is held off until reset and a second reset switch 15 which can interrupt a filling sequence at any point and automatically set it back to the starting condition.

In operation, the container C to be filled is placed on the weighing platform 5 as a result of which the load cell 6 will produce a signal which is displayed on the digital display at 10 as a reading which indicates the weight of the container C, or difference in the container weight after the first fill. A zero control switch 16 is then pressed and operates a relay 17 to put a re-tare circuit 18 into operation. This re-tare circuit 18 is brought into circuit by closure of a zeroing contact 19 of the relay 17. When zero is reached a zero sensing unit identifies zero and puts the circuit in a condition to operate a filling cycle of the apparatus automatically. However, if it is desired to operate the filling cycle manually, manual operation is selected by a selector switch 20. When the first relay 17 is energised it closes a contact 21. A zeroing contact 22 will change over at zero. A condenser 24 across relay 17 acts as a momentary hold during the change over period of contact 22, thus enabling relay 25 to energise. This second relay 25 operates three contacts. One of these contacts (contact 25a) is in parallel with zeroing contact 22 and contact 21. A contact 26 is in series with the electrical supply to the switch 20, and a contact 27 is in series with the first relay 17. An indicator lamp is connected in parallel with relay 25 and this lamp is labelled "zero set". The contact 26 is closed to connect a supply to a control which is used when it is desired to operate the apparatus manually button 28 and the selector or switch 20.

If the manual fill button 28 is pressed it will energise relays 31, 31a and 33. Relay 31a has four contacts one of which is in parallel with the button 28 so that the relay will remain in the energised condition after pressing the button 28. The relays 31 and

31a control the filling sequence and the fill valve 3 supply control input.

With the circuit set to a desired trip weight, a signal will be given when this weight is reached during a filling operation. This signal will operate the contact 30 and connect a fifth relay 60 to the supply. This relay 60 controls, a counter 34 through a relay contact 60a and is so interlocked that when a container has been filled a count will be registered by the counter and displayed on the panel 10. The weight is also supplied in a code output to operate a printer or punch tape 61 system automatically. When a desired weight of fill in the container C is reached relay 64 changes the contact 64a to adjust the valve 3 pneumatic system to a slow fill setting to reduce the filling flow rate, this assists in obtaining accuracy of filling. The relay contact 33a is used to operate a counter 34 which displays the number of completely filled containers. The counter 34 can be reset by the use of a key and is electrically reset when the master key switch 62 is used in conjunction with the press button 63.

Should filling not be sufficient, so that more material is required to complete the fill, the fifth relay can be re-energised by manual operation of a topping up button 35. This fifth relay is held energised while material flows into the container and de-energised by releasing the button 35. This would normally only be necessary up to the time that the final setting of trip controls (to be hereinafter described) in the circuit have been correctly adjusted to correct for any material which may not have reached the container.

In automatic operation the selector switch 20 is closed so that when the second relay 25 is energised the contacts 26 will connect a supply of current straight to relays 31, 31a and 33. The filling sequence will then continue to operate automatically as during the manual cycle.

Relay 29 is used in liquid filling to operate a spout down circuit. This system must operate before filling can commence and is covered by a safety sequence. The weight level identification and zeroing arrangement includes three amplifier circuits, one of which operates the zero set and the other two the trip weight levels.

The first amplifier circuit 36 which consists of two amplifiers in series, controls the zeroing and its signal input is fed from the weighing amplifier 8. The input voltage to the control unit 4 can be at any convenient level providing it is greater than one volt, for a weighing scale up to 10000. The input terminal is returned to zero voltage so that an input signal applied to the other input of the differential amplifier will, when equalling zero, produce an output voltage from the amplifier also equalling zero. This amplifier 36 is balanced to allow for offset currents in the amplifier 36 by a potentiometer which is placed across the negative supply so that its variable input can be fed into a biasing correction point of the amplifier. A gain control varies the feed-back loop in the amplifier 36. This is a potentiometer between the output of the amplifier and earth with a feedback resistance going to the input of the amplifier. This gain control is used to adjust the amount of zero differential to as small a signal as possible (conveniently plus or minus 0.02% of the maximum range of the weighing head). Thus, the zero set would never be able to operate if there was an error of more than 0.02% on the weighing head. The output from amplifier 36 is connected to the two coils 37 and 38 which can only be energised when the voltage at the central point is substantially zero. The amplifier 36 is arranged so that the change-over point will either be an output plus or minus signal of suitable voltage or zero. The contacts of the two relays 37, 38 are in series and supply the relay 39. The contact of relay 39 is of a change/over type, and will change over its contact at zero when not at zero. Relay 37 or 38 will be energised causing a signal from the energised relay contact to supply a voltage to the zero motor 70. During zeroing this motor 70 drives the zero control through a clutch 66. Reed relay 65 (Figure 5a) completes the motor supply. This system selects zero without any overshoot.

A first trip level pre-amplifier 40 has an input switch which selects the filling range required and comprises resistances feeding a potentiometer. The resistances are chosen so that the filling range selected approximates the full range selected when the control is at full range setting. If, for example, the containers are to have a two and a half kilogramme fill, it is only possible to put in approximately two and a half kilogrammes of material before the trip level will be cut off and the filling stopped. There is a margin of about 5 percent above this level so that if a mistake is made and the level set too high the amount of over-flow of material would only be a small percentage for liquid filling this setting has to cover various specific gravities from 0.9 to 1.2 and is therefore calibrated to cover this requirement. The trip set voltage acts as the bias voltage placed at the input to amplifier 42 and the input signal from the weighing amplifier 8 is fed into the second input of this amplifier 42. Thus, when the set level and input level match each other the output of the amplifier 42 will change from negative to zero and then positive. The signal output from the amplifier 42 up

to this point is a full negative signal of suitable voltage. A diode in an output circuit prevents a negative signal from appearing on the base of the transistor, but when a positive signal comes from the amplifier 42 (which will occur if the input voltage exceeds a pre-set voltage), the transistor will pass heavy current and the relay 41 will be energised. A slugging circuit is associated with the relay 41 to avoid chattering of the relay if required.

A second trip level amplifier 67 is similarly fed via a pre-amplifier 68 with an input signal from the weighing head. A slightly higher bias level than that of the amplifier 42 is supplied to this amplifier so that a second filling sequence can take place through a fine flow filling device. Amplifier 67 is an almost identical amplifier unit to that of amplifier 42, (but has a preset bias offset in the pre-amplifier 68 equal to say 50 grms). Its output operates the transistor and relay 43 and closes a contact of relay 43. This contact is in the pneumatic control valve circuit. The amplifier trip-over point is extremely sensitive and can be set to avoid any error in the filling point, a change of less than half a millivolt is required on the amplifiers input to cause a changeover to occur, and stop the filling sequence.

The two trip amplifiers 42 and 67 are fitted with variable gain feed back for sensitivity adjustment, and zero balance controls to adjust any offset input currents. When the start button 11 is pressed, the control unit 4 will only permit a quantity of substance to be dispensed which will not over fill the selected container. The operator may fill any amount of substance up to the maximum that the selected container will hold, by arranging the value at which filling ceases using the control 69 setting the trip level. This part of the filling programme is set using the digital display 9. A small margin over the amount required to fill the container is permitted within each selection of the switch. However, this amount is only sufficient to allow for the differences in the tare weights within the selected container range.

A range selector switch 44 is incorporated in the electronic control unit 4 to provide a margin of safety during the filling part of the cycle. This switch 44 is a multi-position switch which is arranged so that each position represents a different capacity container. When a container is selected for filling, the switch 44 is set to correspond to a full capacity and the switch and variable control 69 is used to set the pre-set weight as indicated on the digital display. This setting is then the cut off point for the filling valve.

The dispensing head 1 is supported on a carriage 45 adjustably mounted on a frame 46 of the machine. Adjusting rods 47 extending through the carriage and have screw-threaded portions co-operating with screw-threads in the carriage so that rotation of a handle 48 will move the carriage from one side of the frame 46 to the other. A similar arrangement controlled by a handle 49 raises or lowers the carriage 45.

The valve 3 has a filling spout 50 through which liquid can pass to the container C to be filled and an inlet branch 51 in which the supply line 2 is received. A valve member 52 is movable into and out of engagement with a valve set 52 to control the flow of liquid. The valve member 52 can be raised against the loading of a spring (not shown) by movement of a plunger rod 55 under the control of an air cylinder 56. The cylinder 56 is supplied with air under pressure through lines 57 which are themselves supplied by the pneumatic control unit 12 in accordance with commands received from the electronic control unit 4.

A further air cylinder 58 powers the filling valve 3 so that the spout 50 enters container C. The material cannot be dispensed until the spout has properly entered the container. The cylinder 58 is also supplied with air under pressure through lines 57.

In a modification, the filling valve 3 is replaced by a rotatable screw conveyor arranged to dispense powder or other particulate material. Rotation of the screw conveyor is started or stopped in response to commands from the control unit 4 in a way similar to the commands opening or closing the valve.

The control unit 4 includes a batch counting device to record each time the full dispensed weight of a container has been monitored.

The device of the invention may, if desired, be used for the blending of a plurality of substances.

The control unit 4 may be arranged to provide command signals to control ancillary equipment such as labelling, capping or similar equipment.

WHAT WE CLAIM IS:—

1. A dispensing apparatus comprising a weighing unit having a platform adapted to receive a container to be charged with substance and a load-cell connected to the platform arranged to produce signals dependent on the weight on the platform; an electronic control unit arranged to receive the signals produced by the load-cell and operable in response to such signals first to sense the tare weight of a container on the platform and then, subsequently, to measure the weight of the

charge supplied to the container; and a dispensing unit automatically operable in response to command signals provided by the electronic control unit to open when the tare weight of the container has been zeroed, and then to close when a predetermined weight of substance has been dispensed into the container.

2. An apparatus as claimed in Claim 1 wherein an amplifier is arranged to receive the signals produced by the load-cell and to pass them to an electronic circuit forming the control unit, and wherein the electronic circuit is operable to transmit commands dependent on signals received from the load cell to open and close a valve through which the substance is supplied into the container.

3. A dispensing apparatus as claimed in Claim 2, wherein the electronic circuit arrangement includes a digital display operable in accordance with signals received from the load-cell and having a display calibrated to give a reading indicative of the weight on the platform, start means manually operable when the reading has been displayed to produce a start signal and to initiate a first command signal to open the valve and subsequently to initiate a second command signal corresponding to a desired weight of charge in the container, means being provided to prevent the transmission of the said command signals before the start signal is received by the electronic circuit arrangement.

4. A dispensing apparatus as claimed in any one of the preceding claims, wherein the dispensing unit includes a carriage mounted on a frame above the platform, means being provided to adjust the height of the dispensing unit above the platform and also to adjust the position of the dispensing unit laterally of itself.

5. A dispensing apparatus as claimed in any one of the preceding claims, wherein the dispensing unit includes a valve which is movable into and out of engagement with a valve seat by pneumatic means in response to command signals received from the control unit.

6. An apparatus as claimed in Claim 1, wherein command signals from the electronic control unit start and stop a conveyor supplying particulate material to the container.

7. A dispensing apparatus substantially as described with reference to the accompanying drawings.

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1459394 COMPLETE SPECIFICATION
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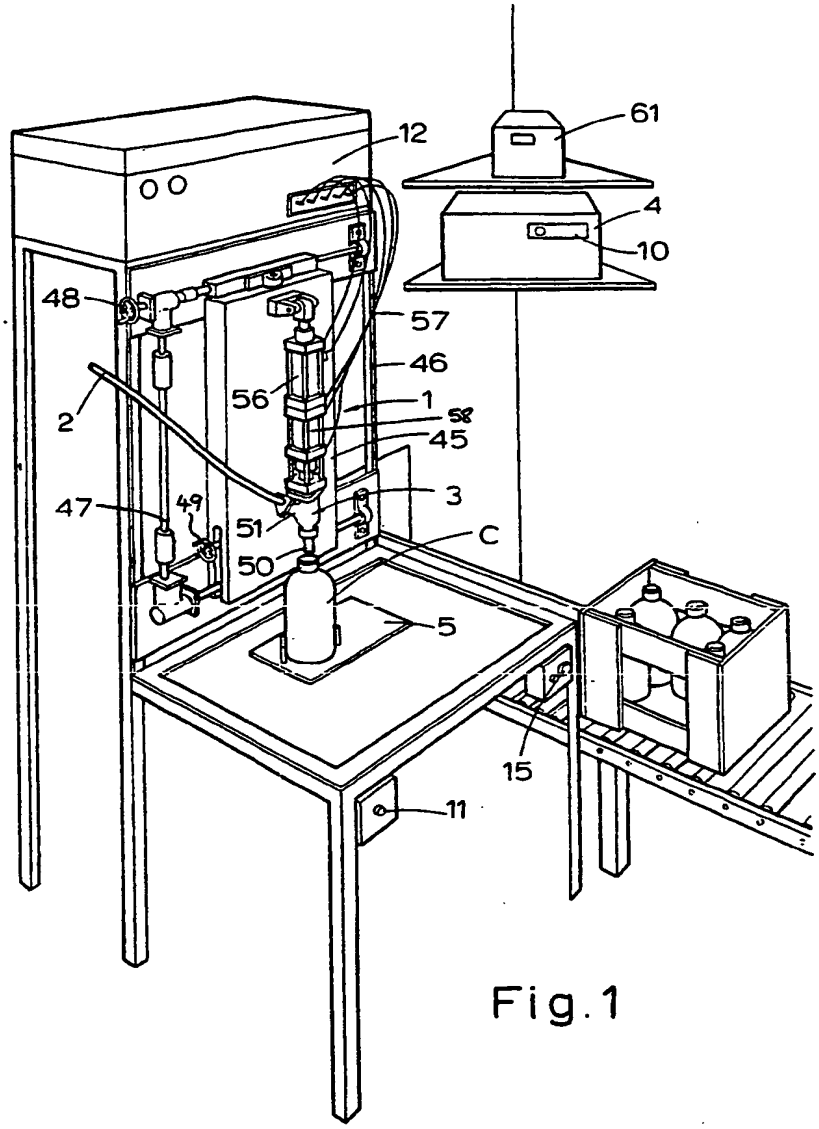

Fig.1

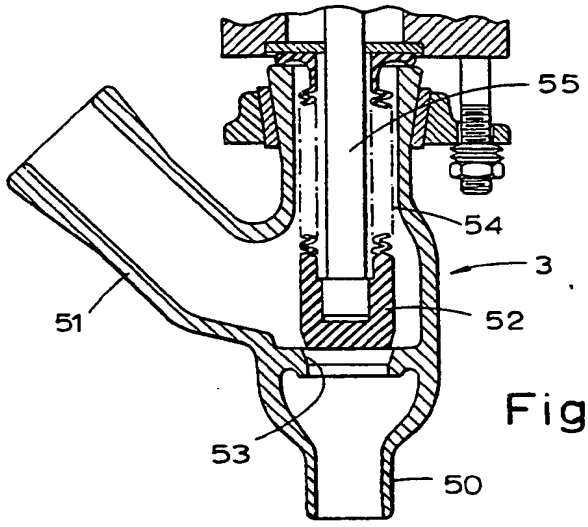

Fig.2

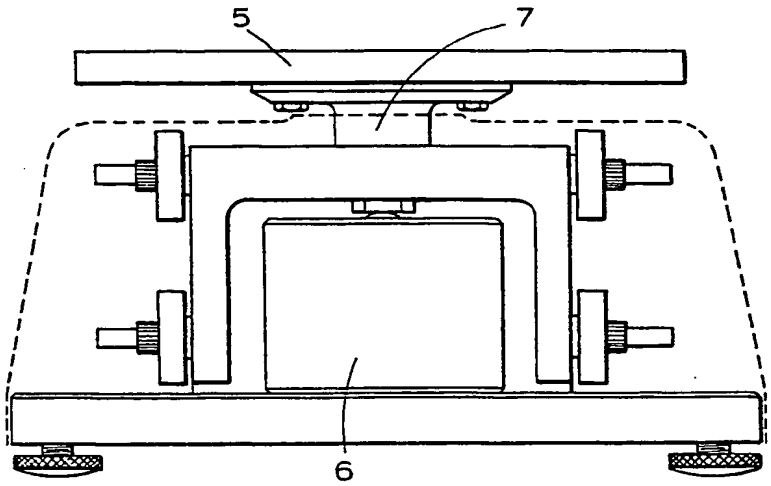

Fig.3

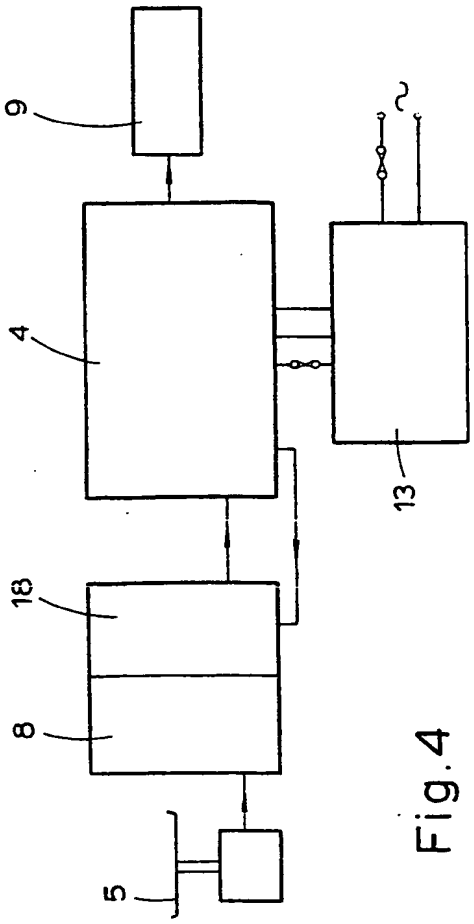

Fig.4

1459394 COMPLETE SPECIFICATION

6 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 4

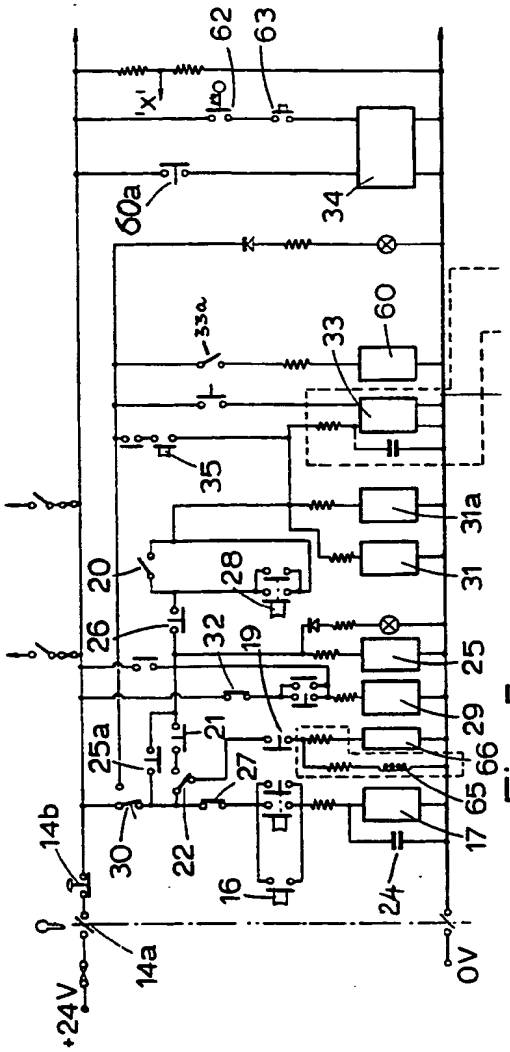

Fig. 5a

1459394 COMPLETE SPECIFICATION
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Sheet 5

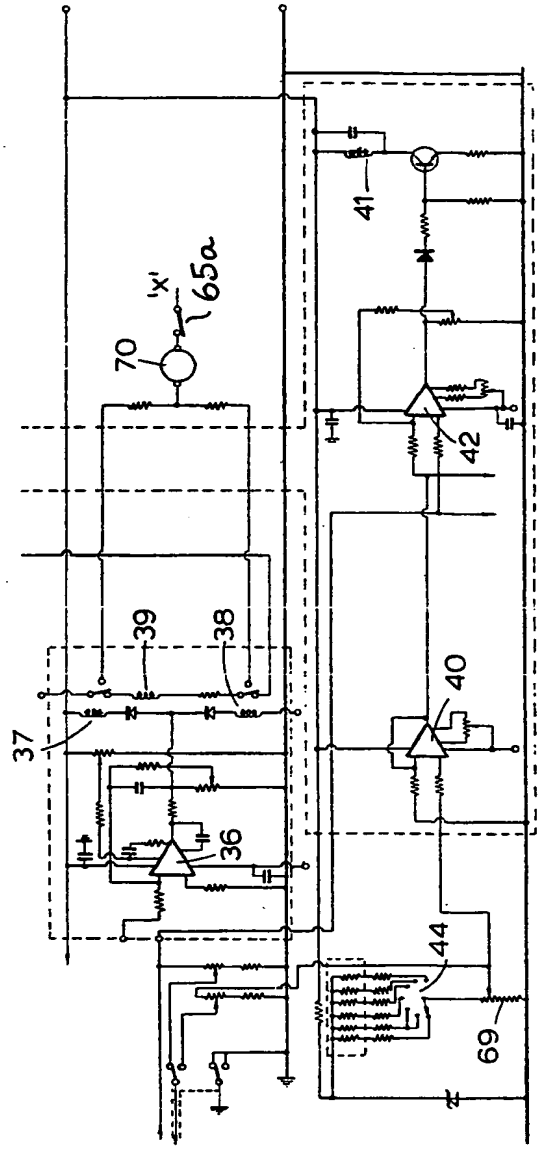

Fig. 5b

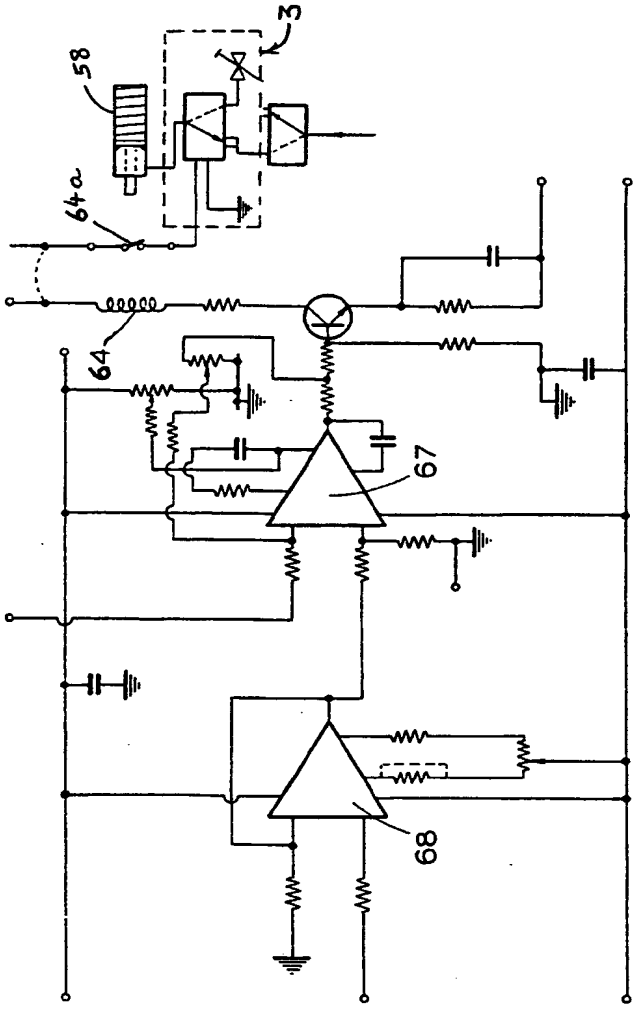

Fig. 5c